In The Claims (*Marked-up Version*)

Please cancel claims 2 to 6 and 8 to 12 and amend the claims in the following manner:

1. (Amended) Method for finding the Reflection Coefficient (RC) of reflectors in the subsurface **of the ground**, said method comprising:

a) migrating to depth recorded traces in a survey by Pre-Stack Depth Migration (PSDM), **using shot/receiver pairs,** thereby achieving a real depth migrated seismic cube $P_{Obs}(\vec{x})$ which is a function of the recorded traces that **have** each [~~has~~] been given a weight $w_i(\vec{x})$;

b) interpreting $P_{Obs}(\vec{x})$ to find the **spatial positions of the** reflectors in the subsurface, **and** based on these reflectors and the seismic velocities, [~~an earth~~] **a depth** model is established in the computer, **and** one of the reflectors in the [~~earth~~] **depth** model is chosen to be the target reflector;

c) computing synthetic traces from the target reflector for all shot/receiver pairs in the survey that was used in a); [~~characterized by~~]

d) setting the RC of the target reflector in the depth model to an essentially constant value when the synthetic traces are computed;

e) doing a local PSDM of the synthetic traces in a band around the target reflector to obtain a modeled PSDM cube $P_{Mod}(\vec{x})$; and

f) measuring the amplitudes along target reflector on the real PSDM cube $P_{Obs}(\vec{x})$, dividing these measurements by the corresponding measurements from the modeled PSDM cube $P_{Mod}(\vec{x})$, thereby obtaining an estimate of the angle dependent RC with corresponding reflection angle and weight function.

7. (Amended) An article of manufacture comprising:

- a computer usable medium having computer readable program code embodied therein for finding the Reflection Coefficient (RC) of reflectors in the subsurface, the computer readable program code in said article of manufacture comprising:

a) [~~computer readable program code~~] **computer program means** for [~~causing~~] **enabling** a computer to [~~migrate to~~] **determine** depth recorded traces in a survey by Pre-Stack Depth Migration (PSDM), **using shot/receiver pairs,** thereby achieving a real depth migrated seismic cube ($P_{Obs}(\vec{x})$) which is a function of the recorded traces that each has been given a weight $w_i(\vec{x})$;

b) [~~computer readable program code~~] **said computer program means including means** for [~~causing~~] **enabling** a computer to interpret $P_{Obs}(\vec{x})$ to find the **spatial positions of** reflectors in the subsurface, **and** based on these reflectors and the seismic velocities [~~an earth~~] **a depth** model is established in the computer, **and** one of the reflectors in the [~~earth~~] **depth** model is chosen to be the target reflector;

c) [~~computer readable program code~~] **said computer program means including means** for [~~causing~~] **enabling** a computer to compute synthetic traces from the target reflector from all shot/receiver pairs in the survey that was used in a);[~~characterized by~~]

d) [~~computer readable program code~~] **said computer program means including means** for [~~causing~~] **enabling** a computer to set the RC of the target reflector in the depth model to an essentially constant value when the synthetic traces are computed;

e) [~~computer readable program code~~] **said computer program means including means** for [~~causing~~] **enabling** a computer to perform a local PSDM of the synthetic traces in a band around the target reflector to obtain a modeled PSDM cube $P_{Mod}(\vec{x})$; and

(f) [~~computer readable program code~~] **said computer program means including means** for [~~causing~~] **enabling** a computer to measure the amplitudes along target reflector on the real PSDM cube $P_{Obs}(\vec{x})$, dividing these measurements with the corresponding measurements from the modeled PSDM cube $P_{Mod}(\vec{x})$, obtaining an estimate of the angle dependent RC with corresponding reflection angle and weight function.

REMARKS

Reconsideration of this application and entry of this amendment is respectfully requested.

Independent claims 1 and 7 have been amended, dependent claims 2-6 and 8-12 have been canceled and replaced by new claims 13-22 and new claims 23-29 have been added.

The examiner rejected claims 1-12 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,094,621 to *Hanitzsch et al*. Applicant respectfully disagrees with the examiner's position because, as hereinafter discussed, applicant's method is fundamentally different from *Hanitzsch et al*, operates differently, and provides different results.

Applicant discusses at pages 6 and 7 of the specification details of five steps used in carrying out applicant's method. Applicant submits that steps 4 and 5 described on page 6, which correspond to subparagraphs e) and f) of applicant's claim 1 are patentably distinctive over *Hanitzsch et al*.

Thus applicant's claim 1 requires,

> "Method for finding the Reflection Coefficient (RC) of reflectors in the subsurface,...said method comprising...doing a local PSDM of the synthetic traces in a band around the target reflector to obtain a modeled PSDM cube $P_{Mod}(\vec{x})$; and measuring the amplitudes along target reflector on the real PSDM cube $P_{Obs}(\vec{x})$, dividing these measurements by the corresponding measurements from the modeled PSDM cube $P_{Mod}(\vec{x})$, thereby obtaining an estimate of the angle dependent RC with corresponding reflection angle and weight function."

In comparison with the above requirements, *Hanitzsch et al* finds a specular ray from a depth point M but does not describe how to find the weight

associated with a specular ray. There is no showing or suggestion in *Hanitzsch et al* of

> "...doing a local PSDM of the synthetic traces in a band around the target reflector to obtain a modeled PSDM cube $P_{Mod}(\vec{x})$..."

Further, in comparing *Hanitzsch et al* with the above quoted requirements of claim 1, *Hanitzsch et al* obtains an estimate of a PSDM depth section with amplitudes that are proportional to reflection coefficients in a model. *Hanitzsch et al* also finds the reflection angle corresponding to a corrected amplitude by using the reflection angle of a previously found specular ray. There is no showing or suggestion in *Hanitzsch et al* of

> "...measuring the amplitudes along target reflector on the real PSDM cube $P_{Obs}(\vec{x})$, dividing these measurements by the corresponding measurements from the modeled PSDM cube $P_{Mod}(\vec{x})$, thereby obtaining an estimate of the angle dependent RC with corresponding reflection angle and weight function."

The examiner at page 3 of Office Action states that *Hanitzsch et al*, at col. 6, lines 34-38 (which is claim 7 of *Hanitzsch et al*) discloses applicant's requirement of

> "Doing a local PSDM of the synthetic traces in a band around the target reflector to obtain a model PSDM cube $P_{Mod}x$..."

Claim 7 of *Hanitzsch et al* is reproduced below

> "7. Method according to claim 1 wherein a plurality of values of the dip are determined for each point M of interest and the specular rays associated with the point M are determined for each of the values of the dip, and then the specular rays are averaged."

Thus *Hanitzsch et al* requires that a plurality of values of the dip are determined for each point M of interest, and the specular rays associated with the point M are determined for each value of the dip, and then the specular rays are averaged. It would be readily apparent to one of ordinary skill in the art that applicant's step (e) is distinctly different from *Hanitzsch et al* and that there is no obvious basis for extrapolating step (e) from *Hanitzsch et al*.

Applicant submits that there is no correlation between claim 7 of *Hanitzsch et al* and applicant's claimed requirement of

> "Doing the local PSDM of the synthetic traces in a band around the target reflector to obtain a model PSDM cube $P_{Mod}x$..."

The examiner further states that *Hanitzsch et al* discloses at col. 6, lines 13-14 *(subparagraphs of Hanitzsch et al's claim 1)* and at col. 6, lines 29-33 *(Hanitzsch et al claim 6)* applicant's requirement

> "...and measuring the amplitude along target reflector on the reel PSDM cube $P_{bs}(x)$ dividing these measurements by the corresponding measurement from the model PSDM cube $P_{Mod}(x)$, thereby obtaining an estimate of the angle dependent RC with corresponding reflection angle and weight function."

The text of *Hanitzsch et al* relied on by the examiner at col. 6, lines 13-14 and 29-33 is reproduced below

> "...calculating a time characteristic and an amplitude characteristic of each of the specular rays, and
> *(from claim 1)...*
> 6. Method according to claim 1, wherein for each specular ray, a relationship between offset and angle of reflection is determined, and then a relationship between reflectivity and angle of reflection is determined, and said relationships are used in an amplitude versus offset technique."

Hanitzsch et al thus finds a reflection angle corresponding to the corrected amplitude found in point M by using the reflection angle of the specular ray. This is distinctly different from applicant's methodology.

It would be readily apparent to one skilled in the art that there are fundamental differences between applicant's method and *Hanitzsch et al*'s method in the way they work and in the results that they give. These differences are based in part on the fact that applicant's method takes into account the source pulse as well as the shape of the reflector in accomplishing the claimed method. These aspects of the invention are not disclosed or suggested in the *Hanitzsch et al* patent, nor is there any obvious basis for extrapolating the methodology therefrom.

Applicant respectfully submits that there is no correlation between the above quoted text from *Hanitzsch et al* and applicant's requirement in subparagraph f) of claim 1. Applicant thus submits that there is no showing or suggestion in *Hanitzsch et al* of applicant's requirement in subparagraph f) of claim 1.

Accordingly it is submitted that claim 1 is patentably distinguishable over *Hanitzsch et al* and allowance thereof is respectfully requested.

Claims 13-17 which depend on claim 1 are likewise submitted as allowable for the reasons supporting allowance of claim 1 as well as the distinctions defined therein.

For example, claim 13 requires that the RC is set to 1.0 in the calculation of the synthetic traces.

Claim 14 requires the same weights in the PSDM in (a) are used in the local PSDM in (e).

Claim 15 requires that the square method or norm method is used for measuring the amplitudes in f).

Claim 16 requires that the process in a) - f) is repeated for points along the target reflector to create a map of the RC for the target reflector.

Claim 17 requires that the synthetic traces in c) are computed by ray tracing.

Allowance of claims 13-17 is thus respectfully requested.

Independent claim 7 is directed to an article of manufacture that includes means for carrying out requirements analogus to requirements in claim 1 Applicant thus submits that claim 7 is allowable for reasons previously discussed in support of allowance of claim 1. Allowance of claim 7 is thus respectfully requested.

Claims 18-22 which depend on claim 7 are likewise submitted as allowable for the reasons supporting allowance claim 7 as well as the distinctions defined therein.

For example, claim 18 requires that RC in d) is set to 1.0 in the calculation of the synthetic traces.

Claim 19 requires that the weights in the PSDM require in a) are used in the local PSDM in e).

Claim 20 requires that the square method or norm method is used for measuring the amplitudes in f).

Claim 21 requires that the process in a) - f) is repeated for points along the target reflector to make a map of the RC for the target reflector.

Claim 22 requires that the synthetic traces in c) are computed by ray tracing.

Allowance of claims 18-22 is thus respectfully requested.

Newly submitted independent claim 23 defines a data set representing the reflection coefficient of subsurface reflectors produced by methodology that is analogus to requirements previously discussed in support of allowance of claim 1. Accordingly it is submitted that claim 23 is allowable for the reasons supporting allowance of claim 1.

Claims 24-29 which depend on claim 23 are likewise submitted as allowable for the reasons supporting allowance of claim 23 as well the distinctions defined therein.

For example, claim 24 requires that the RC is set to 1.0 in the calculation of the synthetic traces.

Claim 25 requires the same weights in the PSDM in (a) are used in the local PSDM in (e).

Claim 26 requires that the square method or norm method is used for measuring the amplitudes in f).

Claim 27 requires that the process in a) - f) is repeating for points along the target reflector to create a map of the RC for the target reflector.

Claim 28 requires that the synthetic traces in c) are computed by ray tracing.

Claim 29 requires a map produced by multidimensional plotting of the data set of claim 23.

Allowance of claims 24-29 is thus respectfully requested.

In view of the foregoing remarks and amendments it is submitted that this application is in allowable condition and allowance thereof is respectfully requested.

Respectfully submitted,

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